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## **Abstract**

A penetration resistant garment that may be comfortably worn by a user while offering protection against injury from a penetrating object, such as a water jet for example, includes a plurality of light-weight, rigid, discrete penetration resistant sections cooperating with and arranged relative to one another to provide a flexible garment. The sections may be layered in an overlapping manner to provide substantially complete coverage extending over an area of desired coverage. Also, a length of the garment may be less than a sum of the lengths of the individual sections.

**PENETRATION RESISTANT GARMENT**

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This application claims the benefit of U.S. Provisional Application No. 60/105,601, under 35 U.S.C. § 119(e), filed on October 26, 1998, which is herein incorporated by reference in its entirety.

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**Background of the Invention**

***Field of the Invention***

This invention relates to penetration resistant garments and more particularly to lightweight, high-pressure water jet penetration resistant garments.

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***Related Art***

Industrial tools utilizing high pressure water jets continue to be developed, such as, for example, metal working and cutting tools in which the water jet is fixed and the workpiece is moved relative to the water jet. Other tools, for example, hand-held gun-like water jet lances in which the operator moves the water jet over a stationary workpiece, have also been developed. These lances are used, for example, to remove coatings, such as paint, from metallic surfaces. In both types of tools, high pressure water pumps capable of delivering up to 40,000 psi supplies the high pressure water to the jet. With increased operating pressures, the overall horsepower of the pumps has also increased, which has resulted in an increase in water flow rates.

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The increase in pressure and flow has increased the risk of serious injury from direct cuts or amputations and infections, especially when using the hand-held water jet lance, for example. Not only does the water jet contain very large energies that will penetrate body tissue very aggressively, the water jet may carry dirt and bacteria into the wound beyond the region of obvious tissue damage.

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The water jet can be thought of as a needle-like penetrator because the diameter of the jet is small. However, unlike a needle, which is defeated when the tip is bent, a water jet continuously renews the sharp focus of penetration. Conventional cut resistant or bullet proof garments offer little protection from a water jet because the fabrics used in such garments are readily cut and eroded by the jet's small intense contact point such that full penetration may occur. In general, once penetration has started, the erosive effect of the water jet destroys all of

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the remaining fabric at the contact point. As a result, the use of high performance fabrics having open, flexible weaves make such fabrics poor candidates for use in protective garments for water jet applications.

Rigid steel or aluminum would offer protection from the erosion of the water jet.

- 5 However, in addition to the added weight, such materials significantly compromise comfort and freedom of motion and thus are generally not suitable for use in protective garments, especially in industrial environments where such characteristics are necessary.

Given the risk in this industry, a number of attempts at safety garments have been developed. DuPont and others, for example, have developed lined suits using penetration resistant fabrics. An example of such a fabric is disclosed in U.S. Patent Nos. 5,565,264 and 5,837,623, which are assigned to the present assignee and which are incorporated herein by reference in their entireties. The suits made from such fabrics are shaped and formed using conventional techniques. For example, the front of the pant of the suit is cut from a continuous piece of the penetration resistant fabric. Alternatively, the penetration resistant fabric may be added as a liner following the basic shape of the outer layer of the garment.

To provide a desired level of penetration resistance while retaining some flexibility, multiple layers of penetration resistant fabric are used. However, these added layers significantly add to the cost and weight of the garment. In addition, the suits, which cover the entire body, tend to hold heat and reduce the evaporative cooling of the wearer, which may result in heat stress.

### **Summary of the Invention**

One aspect of the present invention is directed to a penetration resistant garment for use, for example, in the water jet industry that may be comfortably worn by a user while offering protection against injury from a penetrating object such as a water jet. The penetration resistance of a single layer of the penetration resistant fabric for use in a penetration resistant garment, may be significantly increased when a coating is applied to the fabric. However, the coating may result in a significantly stiff fabric, which may be less desirable for use as a continuous piece of fabric in a penetration resistant garment.

30 Thus, in one embodiment, a penetration resistant garment includes a plurality of light-weight, rigid, discrete penetration resistant sections cooperating with and arranged relative to one another to provide a flexible garment. In another embodiment, the penetration resistant garment

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includes a plurality of penetration resistant panels cooperating with and arranged relative to one another to provide substantially complete coverage. In yet another aspect of the invention, the panels each have a length. The panels cooperate with and are arranged relative to one another such that a length of the garment is less than a sum of the lengths of the individual panels.

5 In still another aspect of the invention, the penetration resistant garment includes a first panel and a second panel joined to the first panel to define a length. The panels are adjustable relative to one another to selectively adjust the length of the panels.

In yet another aspect of the invention, the penetration resistant garment includes an undergarment having penetration resistant properties and a cover removably attached to the  
10 undergarment.

In another aspect of the invention, the penetration resistant garment includes a penetrating resistant fabric and a hardening material cooperating with the fabric.

In yet another aspect of the invention, the penetration resistant garment includes a penetration resistant fabric forming the garment. The garment is adapted to be worn exclusively  
15 on the front or the back of the user.

In still another aspect of the invention, the penetration resistant garment includes a first panel, a second panel and a knee pad coupled between the first and second panels. The knee pad is pivotally connected to the first panel about a first pivot axis and pivotally connected to the second panel about a second pivot axis. The axes are positioned through the knee pad at  
20 predetermined locations such that an effective center of rotation of the first panel, the second panel and the knee pad passes through a center of rotation of the knee of a wearer.

In yet another aspect of the invention, a method of donning at least a section of a penetration resistant garment on a wearer is disclosed. The section includes a knee section having a knee pad, a first panel pivotally connected to the knee pad and a second panel pivotally  
25 connected to the knee pad. The section further includes a thigh section adapted to be adjustable relative to the first panel of the knee section. The method includes the steps of first securing the knee section to the wearer, then attaching the thigh section to the first panel of the knee section. In this manner, the garment may be readily sized for different sized wearers.

In another aspect of the invention, a panel construction use in a penetration resistant  
30 garment is disclosed. The panel construction includes a backing and a penetration resistant material covering the backing. The penetration resistant material occupies an area less than a total area of the backing.

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In yet another aspect of the invention, a panel construction for use in a penetration resistant garment is disclosed. The panel construction includes a backing and a penetration resistant material covering the backing. A laminate is disposed over the penetration resistant material.

5 In still another aspect of the invention, a kit of parts for use in assembling at least a portion of a penetration resistant garment is disclosed. The kit includes at least one penetration resistant panel. The panel is adapted to cooperate with an arranged relative to an adjacent panel to provide substantially complete coverage.

10 In a further aspect of the invention, a panel construction for use in a penetration resistant garment is disclosed. The panel construction includes a backing and at least two layers of penetration resistant material covering the backing.

Various embodiments of the present invention provide certain advantages and overcome certain drawbacks of the conventional techniques. Not all embodiments of the invention share the same advantages and those that do may not share them under all circumstances. This being  
15 said, the present invention provides numerous advantages including the noted advantage of increased protection with decreased physical and heat stress to the wearer.

Further features and advantages of the present invention as well as the structure and operation of various embodiments of the present invention are described in detail below with reference to the accompanying drawings.

#### **Brief Description of the Drawings**

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

25 FIG. 1 is a perspective view of a penetration resistant garment according to one embodiment of the present invention shown on a wearer;

FIG. 2 is a front view of a torso section of the garment of FIG. 1;

FIG. 3 is a rear view of the torso section of FIG. 2;

FIG. 4 is an exploded view of the torso section of FIG. 2;

FIG. 5 is a front view of a chaps section of the garment of FIG. 1;

30 FIG. 6 is an exploded view of a leg section of the chaps section of FIG. 5;

FIG. 7 is perspective view showing adjustment of the chaps section according to the present invention;

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FIG. 8 is a front view of a gaiter section of the garment of FIG. 1;

FIG. 9 is an exploded view of the gaiter section of FIG. 8;

FIG. 10 is a perspective view of the gaiter section of FIG. 8;

FIG. 11 is a perspective view of single panel of the garment according to the present invention;

FIGS. 12a and 12b are cross-sectional views of alternative embodiments of the panel taken along line 12-12 of FIG. 11;

FIG. 13 is front view of a pair of chap covers for use with the garment of FIG. 1; and,

FIGS. 14 and 15 are diagrammatic representations of alternative embodiments of the present invention.

### **Detailed Description**

A penetration resistant garment that may be comfortably worn by a user while offering protection against injury from a penetrating object, such as a water jet for example, includes a plurality of light-weight, rigid, discrete penetration resistant sections cooperating with each other to provide a flexible garment offering substantially complete coverage extending over an area of desired coverage. The sections or panels may be layered in an overlapping manner to provide the substantially complete coverage for the garment such that a length of the garment is less than a sum of the lengths of the individual sections or panels to aid in protecting the wearer from penetration while keeping the wearer dry and clean. Sufficient overlap is provided to maintain adequate coverage of the wearer when the garment is bent during use as the wearer bends. In one embodiment, the panels are arranged to overlap in a vertical manner from the top of the garment to the bottom to reduce the likelihood that water will run behind the garment onto the wearer.

Although reference is made to use of the present invention for added protection when using a water jet, the present invention may be used in any environment requiring added protection from penetration of other fluids or objects.

Figure 1 is a perspective view of the penetration resistant garment 20 according to the present invention shown worn by a wearer 22 using a lance-type water jet device 24. The garment 20 includes a plurality of penetration resistant panels 30, shown as 30a-30k and collectively referred to as panels 30, a torso section 32 (shown in more detail in Figures 2-4), a chaps section 34 (shown in more detail in Figures 5-7), and a gaiter section 36 (shown in more detail in Figures 8-10). Although only three sections are shown and described herein, it is to be

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appreciated that other sections covering other parts of the wearer's body may be provided using the construction of the present invention. For example, arm sections may be provided, which may be constructed and arranged similar to the thigh section and knee section, thereby allowing bending of the wearer's arm. The shoulder and neck may be protected with separate panels joined to the torso section. In addition, although the garment described herein is adapted for use with a human, the panels may be arranged to conform to the shape of any desired animal that may be used in environments requiring protection.

According to one aspect of the invention, the panels 30 cooperate with one another in a manner such that the garment 20 remains flexible. In one embodiment, as will be fully described hereinafter, the panels slide relative to one another. In another embodiment, the panels are pivotally connected to one another. In any event, it is to be appreciated that the panels, which individually may be rigid, cooperate in a manner such that the overall garment is flexible and therefore comfortable for the wearer.

Referring now to Figures 2-4, the torso section 32 includes a chest panel 40 generally shaped according to the chest of a wearer. The torso section 32 also includes a left waist panel 42 and a right waist panel 44, both coupled to the chest panel and both generally shaped to conform to the waist area and hip area of a wearer. Preferably, the waist panels are coupled to the chest panel with the use of pivot pins 46, 48 passing through respective holes formed in the panels. To provide adjustability in the length of the torso section, a plurality of fastening locations may be provided. For example, a plurality of holes 49 may be provided. The pivot pins may be any suitable fastener. Preferably, the fastener permits pivoting of the two panels and, as will be described hereinafter, allows removing and replacing a panel. In one embodiment, the fasteners are formed by a screw 50 and "T" nut 52 (see Figure 4). Other fastening means envisioned include a snap fastener or a rivet. The waist panels 42 and 44 are attached to the chest panel at outside portions 54 and 56, respectively. As a result, when the torso section is placed on the wearer and wrapped around the waist of the wearer to conform to the upper body, the waist panels are permitted to pivot about the pivot pins to allow increased flexibility of the garment.

If pivoting between the waist panels and the chest panel is not a requirement, for example, if the user is not required to bend, but adjustability is desired, other suitable fasteners may be used, such as a hook and loop fastener (not shown). As will be discussed with reference to the thigh section, the hook and loop fastener may provide adjustability in the overall length of

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two adjacent panels while also securing them together. Thus, in this regard, the chest panel 40 may be adjusted relative to the waist panels by positioning and attaching the hook and loop fastener at a desired fastening location.

The torso section 32 also may include a groin panel 58 coupled between the waist panels and attached to the waist panels at inside portions 59a and 59b, respectively, of the waist panels with pivot pins 60, 62. The groin panel 58 also is attached to the chest panel at an upper location 63 of the groin panel with pivot pins 68, 70. The pivot pins may be any suitable fasteners as described above. In the embodiment described herein, the pivot pins are formed by a screw and a "T" nut. Of course, the groin panel may be adjustable relative to the chest and waist panels in a similar manner as described above with reference to the waist panels.

As best shown in Figure 3, shoulder straps 72, 74, which may be made of any suitable material such as a woven web, are attached to the chest panel 40 to allow the torso section to be worn like a vest. The straps may criss-cross to provide greater secureness of the torso section to the wearer. However, according to one aspect of the invention, the torso section preferably is loosely fit on the wearer to provide for air flow between the garment and the wearer to allow for adequate cooling of the wearer. In addition, the straps may be adjustable provided that the wearer is able to maintain adequate air flow between his or her body and the garment. Although according to one embodiment the garment may be adapted to be worn exclusively on the front or back of a wearer for added cooling, the back and buttocks may be protected by additional panels as desired. In such an embodiment, the garment portions protecting the back and buttocks also preferably are loosely fit on the wearer.

To secure the bottom portion of the torso section to the wearer, a third strap 76 may be used. In one embodiment, the strap may be secured to the bottom section 78 of the groin panel 58 and attached to the straps 72, 74. This strap also may be adjustable as described above. In addition, the strap may include a snap buckle 80a, 80b to provide ease of placing the torso section on the wearer.

Referring now to Figures 5-7, the panels are configured to form a chaps section 34. The chaps section includes first 90 and second 92 leg sections. For the sake of convenience, the construction and arrangement of the chaps section will be discussed with reference to one leg section with the understanding that the other leg section is of similar construction and arrangement. Although it is to be appreciated that the leg sections discussed herein are similar, they may be adapted slightly to accommodate the left or right leg or may be constructed and

arranged to offer greater protection to one leg or to certain areas of the leg, as may be desired. In addition, although the chaps section described herein provides added protection to the front of the legs only, the back of the legs may be protected with or without front leg protection by additional or alternative panels as desired.

5 Each leg section includes a thigh section 94, which, in this example, is constructed from one panel, and a knee section 96. The knee section 96 includes an upper knee panel 98, a lower knee panel 100 and a knee pad 102 coupled between the upper and lower panels. The upper panel is adjustably secured to the thigh panel. One or more straps 104 with associated buckles may be used to secure the chaps section to the leg of the wearer and may be held up with one or  
10 more loops 106, which may be used to attach the chaps section to a belt 108. In one embodiment, the straps 104 are adjustable in a manner described above with respect to the torso section 32 and may or may not be formed of elastic webbing. In any event, preferably, the chaps section is loosely held to the legs so as to allow adequate air flow for cooling. An outhaul strap 110 may also be provided to restrict movement or rotation of a leg section toward the inner thigh of the wearer. The strap may include a buckle to adjust the length of the strap to accommodate  
15 the height of the user.

As shown in Figure 1, the torso section is constructed and arranged to sufficiently overlie the chaps section to offer adequate protection and water shedding, even as the wearer bends. In addition, the torso section is permitted to slide relative to the chaps section to provide the wearer with unrestricted movement while bending or turning.  
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The knee section 96 includes a first pair of pivot pins 112 pivotally securing the knee pad 102 to the upper knee panel 98 about a first pivot axis and a second pair of pivot pins 114 pivotally securing the knee pad 104 to the lower panel 100 about a second pivot axis. The first and second pairs of pivot pins may be positioned through the knee pad at predetermined  
25 locations such that an effective center of rotation of the upper panel, the lower panel and the knee pad passes through a center of rotation of the knee of a wearer. Of course, as described with reference to the torso section, the pivot pins may be formed of any suitable fastener such as a screw and "T" nut or snap fasteners. Hook and loop fasteners may be used if pivoting is not a requirement.

30 As best shown in Figures 6 and 7, the upper knee panel 98 may be adjustably secured to the thigh panel 94 with the use of a hook and loop fastener 120. In this manner, the length of the leg section 92 may be fitted to the wearer by moving the location of the attachment area of the

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hook and loop fastener. Of course, those skilled in the art will recognize that other fasteners may be used to adjust the length of the leg section. For example, a plurality of mounting holes 122 may be formed in the thigh panel to receive a snap fastener, a rivet, a screw and "T" nut or the like. The preferred amount of adjustment accommodates wearers having an inseam length of 24" to 38". Accordingly, the amount of overlap is about 4" to 6". As described above with reference to the torso section, any of the panels forming a leg section may be replaced as desired. The chaps section may be donned by first securing the knee section to the wearer, then attaching the thigh panel to the first panel of the knee section. In this manner, the chaps section may be readily sized for different sized wearers.

Referring now to Figures 8-10, the garment 20 further includes a gaiter section 36. The gaiter section 36 includes first and second shin panels 130, 131, an ankle panel 132 and a foot panel 134. In one embodiment, the foot panel 134 is adapted to extend up to the steel toe of the shoe of the wearer. The shin panels and the ankle panel are secured together with pivot pins 136 at a position adapted to allow ankle rotation of the gaiter section when worn by a wearer. The two shin panels are shaped with similar arc sections such that upon bending by the wearer, the second shin panel 131 is able to slide, at least partially, under the first shin panel 130 as can be seen in Figure 10. Although two shin panels are shown and described, it is to be appreciated that only one shin panel may be provided. The ankle panel and the foot panel are secured together with similar pivot pins 137 at a second hinge point that coincides with the ball area of the user's foot such that the user may articulate the foot at the toe area as shown in Figure 10. With such a double hinge arrangement, the gaiter section allows the user to bend to a maximum extent.

The pivot pins 136 may be formed of any suitable fastener as described above, such as a screw and "T" nut shown. One or more straps 138 may be provided to secure the gaiter section. In addition, a heel strap 140, which may be formed of an elastic webbing or band, may be used to secure the heel area of the gaiter section. The heel strap may be fixed to pivot pins 136, as shown in Figure 8, or may be attached at any other suitable location on the gaiter section, such as the shin panel 130, as shown in Figure 10. Preferably, the chaps section 34 is adapted to cover the shin panel 130 to provide a garment having continuous coverage.

With the cooperation of one panel to one or more adjacent panels, the garment may provide substantially complete coverage over a desired area of protection of the user. Thus, the panels are arranged in any suitable manner such that a full coverage of a selected area is possible while a single panel may cover less than the desired area.

According to another aspect of the invention, the garment may be provided in a kit of parts containing at least some of the individual panels, fasteners, and straps to allow a user to assemble and wear the garment once it has been partially or completely assembled. Also, replacement parts may be provided in one or more kits. The kits may also be provided with  
5 selected components such that a user may arrange a specific assembly suitable for a specific need.

In one embodiment, the panels have curved corners for added comfort and the panels themselves may be curved to conform to the particular body part for which the panel protects. In addition, the sides on some panels are curved and complement the shape of adjacent panels. For  
10 example, the waist panels are formed with a concave side 148 (see Figure 2) on a side of the panel facing the lower and outer thigh of the wearer's leg so as to complement the bend formed on the chaps that offers protection to the inner and outer leg. The concave side of the waist panels and the bend formed on the chaps may also facilitate sliding of the waist panels over the chaps without binding. Also, the groin panel is formed as an elongated panel having curved  
15 edges to provide protection when the wearer's knees are straight and when they are bent without causing binding or otherwise constraining the wearer.

As shown in Figures 11 and 12, each panel may include a backing 150, with the penetration resistant material 152 covering the backing. The penetration resistant material occupies an area less than a total area of the backing. The penetration resistant material may  
20 cover the backing such that an edge 154 of the backing remains exposed. The backing may be formed of a closed cell low moisture polyethylene foam material or a polyester material. The backing provides added comfort to the wearer and the exposed edge reduces discomfort if the panels wedge into a body part, such as, for example, the thigh, of the wearer. A liner 156 formed of a soft fabric may be used to cover the foam. Preferably, the liner is made of polypropylene or  
25 polyester filament fabrics, however, any fabric that is easy to clean and provides low or no water retention may be used.

The penetration resistant material 152 of the present invention may be formed of an ultra-tight woven fabric material made of high tenacity yarns, such as that developed by the inventors of the present invention and disclosed in U.S. Patent Nos. 5,565,264 and 5,837,623. Other  
30 suitable fabrics made of high strength fibers of greater than 8 grams per denier and less than 10% elongation at break may be used. Examples of such fibers includes: para-arimid fibers including, for example, Kevlar®, manufactured by Du Pont, Charlotte, NC; Twarmon®, manufactured by

AXZO Nobel Industrial Fibers, Inc., Scottsboro, AL; Technoroa®, manufactured by Teijan, Osaka, Japan; Trevir® manufactured by Kosa, Charlotte, NC; ultra high molecular polyethylene fibers including, for example, Spectra®, manufactured by AlliedSignal Inc., Atlanta, GA; Dynema®, manufactured by DSM "The Polymer Corp.", Reading, PA; Certran®, which may be  
5 manufactured by Hoescht Celenese, Salisbury, NC; Vectran® fibers, manufactured by Hoescht Celenese, Salisbury, NC; carbon fiber; or glass fibers.

To increase the penetration resistance of the material 152, the material may cooperate with a hardening material. For example, the hardening material may be coated on the penetration resistant fabric or may be saturated therein. In addition, the hardening material may include a  
10 filler of a crystalline material adhered thereto. The epoxy and filler provide resistance to the erosive effect of the water jet. Examples of such an epoxy include epoxy resins, cross-linked polyester resins and also polyether resins. Examples of such a crystalline material includes ceramic, garnet, metal, silicon carbide, aluminum oxide and diamond. The crystalline material may be in a fine grain powder form and may have a mesh size of at least 150 or finer, for  
15 example, 600.

Preferably, the penetration resistant fabric has a very tight woven construction. Saturation and/or coatings and/or laminations and/or calendaring may be used to further bind the filaments of the fabric together. However, any material that is added to the woven fabric should have excellent adhesion to the fiber. For example, the use of an epoxy when using a para-arimid  
20 provides adequate adhesion.

In another embodiment, also shown in Figure 12a, which is a cross-sectional view of Figure 11 taken along line 12-12, a laminate 158 may be disposed over the penetration resistant material to allow ease of water shedding and cleaning. The laminate may be formed of a low friction material, such as polypropylene, and may have a thickness of about 2 mils. In another  
25 embodiment, the laminate may be formed as a woven material that is hot glued and stitched to the penetration resistant fabric. Preferably, this laminate fabric provides high durability and abrasion resistance. In one embodiment, the fabric used in the laminate may include synthetic yarns, which may be made up of individual filaments or multiple filaments. Each filament may have a denier of not less than 50.

30 In another embodiment, as shown in Figure 12b, which is a cross-sectional view of an alternative embodiment of Figure 11 taken along line 12-12, the panel may be constructed of multiple layers of penetration resistant fabric 152. In addition, to further increase the penetration

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resistance of the garment, a spacer material 180 may be placed between two or more layers of the penetration resistant material 152. In this regard, the spacer material may alternate between single layers of the penetration resistant material 152 or between multiple layers of the penetration resistant material 152. The spacer material 180 preferably deflects and distorts the water jet hitting the garment as the water jet penetrates the outer layer. In one embodiment, the spacer material separates the layers by a distance of about .015" to about .025".

The spacer may be formed of a fabric composed of synthetic yarns. The yarns may be made up of individual filaments or multiple filaments. Each filament may have a denier of not less than 50. Alternatively, the spacer 180 may be formed of a fibrous felt or foam having, in part, synthetic yarns. In another alternative, the spacer may be formed of both a synthetic yarn (made of individual or multiple filaments having a denier not less than 50) and the fibrous felt or foam and may be formed in a layered construction.

According to another aspect of the invention, the garment may include a cover adapted to cover all or a portion of the side of the garment facing away from the wearer. Referring now to Figure 13, removable covers 160, 162 are shown adapted to cover each leg section of the chaps section 34. The covers may include slits 164 to receive the straps attached to the panels. Thus, the wearer may weave the straps through the slits, thereby securing the cover to the panel. Of course, other suitable attaching means may be employed. For example, snaps, adhesives, or hook and loop fasteners may be used.

Due to the water and waste associated with water jet operations, operators of water jet lances generally wear commercial rain suits having rubber boots, plastic or rubber coated pants and hooded jacket. This rain gear becomes contaminated by sticky waste, which requires the disposal of the rain gear after a brief period of use. In addition, because of the high physical exertion associated with water jetting, full coverage protective gear and rain suits are not desirable as they tend to prevent evaporation and retain body heat.

Preferably, the covers are made of a material that economically allows the covers to be disposable, yet offer water resistance, thereby protecting the garment from dirt and grime, which may tend to reduce the useful life of the garment. An example of such a material is spun bonded olefin, which has a low cost, high tear resistance, high water resistance and high slip surface properties. In addition, little water falls on the back of the wearer's legs. Thus, preferably, the covers are adapted to cover only the front portion of the wearer, thereby maintaining a low cost and providing adequate cooling for the wearer.

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According to another aspect of the invention, the garment may include a base material adapted for wearing by a user. Such a base material may be formed as pants or a shirt which the user wears or which is strapped onto the wearer. According to this aspect of the invention, which is shown in Figure 14 as a leg section, the panels 30 are secured to the outer surface of the base material 170 using any suitable fastening means, such as a hook and loop fastener or snaps. The panels are secured to the base material in an overlapping manner, as described above, but, in this embodiment, cooperate with the base material such that the base material may flex at an intersection between adjacent panels. Thus, in this embodiment, attaching the panels to one another may not be necessary. In a similar embodiment, which is shown in Figure 15, the base material 170 may include at least one pocket 172. The panels 30 are placed in the pocket 172 in an overlapping manner, although, as shown in Figure 15, one panel is being placed into the pocket while others are already inserted therein. In this example, the base material formed with a pocket provides not only the required flex for the panels, but also acts as the disposable cover.

While the best mode for carrying out the invention has been described in detail, those skilled in the art to which this invention relates will recognize various alternative embodiments including those mentioned above as defined by the following claims.

What is claimed is:

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CLAIMS

Sub 97 1. A penetration resistant garment comprising:  
2 a plurality of penetration resistant panels cooperating with and arranged relative to one  
3 another to provide substantially complete coverage extending over an area of desired coverage.

1 2. A garment according to claim 1 wherein said panels are layered in an overlapping  
2 manner.

1 3. A garment according to claim 1 wherein at least some of said panels cooperate with one  
2 another such that a panel is adapted to slide relative to an adjacent panel.

1 4. A garment according to claim 1 further comprising a pivot pin, wherein said at least some  
2 of said panels are joined together with said pivot pin.

1 5. A garment according to claim 1 further comprising a hook and loop fastener, wherein at  
2 least some of said panels are joined together with said hook and loop fastener. *Need 103*

1 6. A garment according to claim 1 further comprising a base material adapted for wearing  
2 by a user, with said panels being secured to an outer surface of said base material. *Need*

1 7. A garment according to claim 1 further comprising a base material adapted for wearing  
2 by a user, with said base material comprising at least one pocket, with said panels being disposed  
3 within said at least one pocket. *Need*

1 8. A garment according to claim 1 further comprising a base material adapted for wearing  
2 by a user, with said panels cooperating with said base material such that said base material may  
3 flex at an intersection between adjacent panels. *Need*

Sub 97 9. A garment according to claim 1 wherein said continuous layer defines a length, with at  
2 least some of said panels cooperating with each other such that said length of said continuous  
3 layer may be adjusted. *ante ?*  
*15*



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- 1 ~~10.~~ A garment according to claim 1 wherein any of said panels forming said garment is  
2 replaceable.
- 102

- Sub 37
- 1 11. A garment according to claim 1 further comprising at least one strap for a wearer to don  
2 said garment.
- 102

- 1 ~~12.~~ A garment according to claim 1 wherein said garment is adapted to be worn exclusively  
2 on one of a front or back of a wearer.
- 102

- 7
- 1 ~~13.~~ A garment according to claim 1 wherein each said panel comprises a backing and a  
2 penetration resistant fabric covering said backing, with said penetration resistant fabric  
3 occupying an area less than a total area of said backing.
- Need

- 8
- 1 ~~14.~~ A garment according to claim ~~13~~ wherein said backing includes an edge, with said  
2 penetration resistant fabric covering said backing such that said edge of said backing remains  
3 exposed.
- 7
- Need

- 9
- 1 ~~15.~~ A garment according to claim 1 wherein each said panel comprises a backing, a  
2 penetration resistant fabric covering said backing, and a laminate disposed over said penetration  
3 resistant fabric.
- Need

- 10
- 1 ~~16.~~ A garment according to claim 1 further comprising a cover removably covering at least  
2 one of said panels.
- Need

- 11
- 1 ~~17.~~ A garment according to claim 1 wherein each said panel comprises a penetration resistant  
2 fabric and a hardening material cooperating with said penetration resistant fabric.

- 12
- 1 ~~18.~~ A garment according to claim ~~17~~ wherein each said panel further comprises a crystalline  
2 material adhered to said hardening material.
- 11
- 110

1 ~~19.~~ <sup>13</sup> A garment according to claim ~~18~~ <sup>12</sup> wherein said crystalline material is selected from the  
2 group consisting of ceramic, garnet, metal, silicon carbide, aluminum oxide and diamond.

1 ~~20.~~ <sup>14</sup> A garment according to claim 1 wherein at least some of said panels are configured to  
2 form a torso section, with said torso section comprising a chest panel, a left waist panel attached  
3 to said chest panel, a right waist panel attached to said chest panel and a groin panel attached to  
4 said chest panel and said waist panels.

1 ~~21.~~ <sup>15</sup> A garment according to claim 1 wherein at least some of said panels are configured to  
2 form a chaps section, with said chaps section comprising first and second leg sections, with each  
3 said leg section comprising a thigh panel and a knee section, said knee section comprising an  
4 upper knee panel, a lower knee panel and a knee pad coupled between said upper and lower  
5 panels, with said upper panel being adjustably secured to said thigh panel.

1 ~~22.~~ <sup>16</sup> A garment according to claim ~~21~~ <sup>15</sup> wherein said thigh panel is adapted to receive an  
2 outhaul strap.

1 ~~23.~~ <sup>17</sup> A garment according to claim ~~21~~ <sup>15</sup> wherein said knee pad is pinned to said upper panel  
2 with a first pair of pivot pins and pinned to said lower panel with a second pair of pivot pins, said  
3 first and second pairs of pivot pins being positioned through said knee pad at predetermined  
4 locations such that an effective center of rotation of said upper panel, said lower panel and said  
5 knee pad passes through a center of rotation of the knee of a wearer.

1 ~~24.~~ <sup>18</sup> A garment according to claim 1 wherein at least some of said panels are configured to  
2 form a gaiter section, with said gaiter section comprising at least one shin panel, an ankle panel  
3 and a foot panel, with said shin, ankle and foot panels being pinned together at one or more  
4 locations to allow at least one of ankle rotation and toe articulation of said gaiter section when  
5 worn by a wearer.

25. A penetration resistant garment comprising:  
a plurality of penetration resistant panels, each having a length, cooperating with and  
arranged relative to one another such that a length of said garment is less than a sum of the  
lengths of said panels.

26. A garment according to claim 25 wherein said panels are layered in an overlapping  
manner.

27. A garment according to claim 25 wherein at least some of said panels cooperate with one  
another such that a panel is adapted to slide relative to an adjacent panel.

28. A garment according to claim 25 further comprising a pivot pin, wherein said at least  
some of said panels are joined together with said pivot pin.

29. A garment according to claim 25 further comprising a hook and loop fastener, wherein at  
least some of said panels are joined together with said hook and loop fastener.

30. A garment according to claim 25 further comprising a base material adapted for wearing  
by a user, with said panels being secured to an outer surface of said base material.

31. A garment according to claim 25 further comprising a base material adapted for wearing  
by a user, with said base material comprising at least one pocket, with said panels being disposed  
within said at least one pocket.

32. A garment according to claim 25 further comprising a base material adapted for wearing  
by a user, with said panels cooperating with said base material such that said base material may  
flex at an intersection between adjacent panels.

33. A garment according to claim 25 wherein at least some of said panels cooperate with  
each other such that said length of said continuous layer may be adjusted.

1 34. A garment according to claim 25 wherein any of said panels forming said garment is  
2 replaceable.

35. A garment according to claim 25 further comprising at least one strap for a wearer to don  
said garment.

36. A garment according to claim 25 wherein said garment is adapted to be worn exclusively  
on one of a front or back of a wearer.

37. A garment according to claim 25 wherein each said panel comprises a backing and a  
penetration resistant fabric covering said backing, with said penetration resistant fabric  
occupying an area less than a total area of said backing.

38. A garment according to claim 37 wherein said backing includes an edge, with said  
penetration resistant fabric covering said backing such that said edge of said backing remains  
exposed.

39. A garment according to claim 25 wherein each said panel comprises a backing, a  
penetration resistant fabric covering said backing, and a laminate disposed over said penetration  
resistant fabric.

40. A garment according to claim 25 further comprising a cover removably covering at least  
one of said panels.

41. A garment according to claim 25 wherein each said panel comprises a penetration  
resistant fabric and a hardening material cooperating with said penetration resistant fabric.

42. A garment according to claim 41 wherein each said panel further comprises a crystalline  
material adhered to said hardening material.

43. A garment according to claim 42 wherein said crystalline material is selected from the  
group consisting of ceramic, garnet, metal, silicon carbide, aluminum oxide and diamond.

310 19  
1 ~~44.~~ A garment according to claim ~~25~~ wherein at least some of said panels are configured to  
2 form a torso section, with said torso section comprising a chest panel, a left waist panel attached  
3 to said chest panel, a right waist panel attached to said chest panel and a groin panel attached to  
4 said chest panel and said waist panels.

35X 19  
1 ~~45.~~ A garment according to claim ~~25~~ wherein at least some of said panels are configured to  
2 form a chaps section, with said chaps section comprising first and second leg sections, with each  
3 said leg section comprising a thigh panel and a knee section, said knee section comprising an  
4 upper knee panel, a lower knee panel and a knee pad coupled between said upper and lower  
5 panels, with said upper panel being adjustably secured to said thigh panel.

376 37X  
1 ~~46.~~ A garment according to claim ~~45~~ wherein said thigh panel is adapted to receive an  
2 outhaul strap.

39 37  
1 ~~47.~~ A garment according to claim ~~45~~ wherein said knee pad is pinned to said upper panel  
2 with a first pair of pivot pins and pinned to said lower panel with a second pair of pivot pins, said  
3 first and second pairs of pivot pins being positioned through said knee pad at predetermined  
4 locations such that an effective center of rotation of said upper panel, said lower panel and said  
5 knee pad passes through a center of rotation of the knee of a wearer.

40 19  
1 ~~48.~~ A garment according to claim ~~25~~ wherein at least some of said panels are configured to  
2 form a gaiter section, with said gaiter section comprising at least one shin panel, an ankle panel  
3 and a foot panel, with said shin, ankle and foot panels being pinned together at one or more  
4 locations to allow at least one of ankle rotation and toe articulation of said gaiter section when  
5 worn by a wearer.

1 49. A penetration resistant garment comprising:  
2 a first panel;  
3 a second panel joined to said first panel thereby defining a length, said panels being  
4 adjustable relative to one another to selectively adjust said length.

20

1 61. A garment according to claim 59 wherein said crystalline material is in a powder form.

1 62. A garment according to claim 61 wherein said crystalline material has a mesh size of at  
2 least 150 or finer.

1 63. A penetration resistant garment comprising:  
2 a penetration resistant fabric forming said garment, with said garment being adapted to be  
3 worn exclusively on one of a front and a back of a user.

1 64. A garment according to claim 63 wherein said fabric is adapted to be loosely secured to  
2 the wearer in a manner such that said fabric may move away from the wearer, thereby allowing  
3 air flow between the wearer and said fabric.

43  
1 65. A penetration resistant garment comprising:  
2 a first panel;  
3 a second panel;  
4 a knee pad coupled between said first and said second panels, said knee pad being  
5 pivotally connected to said first panel about a first pivot axis and pivotally connected to said  
6 second panel about a second pivot axis, said first and second pivot axes being positioned through  
7 said knee pad at predetermined locations such that an effective center of rotation of said first  
8 panel, said second panel and said knee pad passes through a center of rotation of the knee of a  
9 wearer.

44  
1 66. A method of donning at least a section of a penetration resistant garment on a wearer, the  
2 section having a knee section comprising a knee pad, a first panel pivotally connected to the knee  
3 pad and a second panel pivotally connected to the knee pad, the section further comprising a  
4 thigh section adapted to be adjustable relative to the first panel of the knee section, with said  
5 method comprising the steps of:  
6 first securing the knee section to the wearer; then,  
7 attaching the thigh section to the first panel of the knee section to obtain a desired length  
8 of the section of the penetration resistant garment.

21

- 1 75. A panel construction according to claim 71 wherein said laminate comprises a synthetic  
2 yarn formed of at least one of a single and multiple filaments, said yarn having an denier of  
3 greater than 50.

- 1 ~~76.~~ 49 45 A kit of parts for use in assembling at least a portion of a penetration resistant garment,  
2 with said kit comprising:  
3 at least one penetration resistant panel, with said panel being adapted to cooperate with  
4 and arranged relative to adjacent panels to provide substantially complete coverage extending  
5 over an area of desired coverage.

- 1 ~~77.~~ 50 46 A kit of parts according to claim 76 further comprising a plurality of pivot pins, wherein  
2 at least some of said panels is adapted to be joined together with at least one of said pivot pins.

- 1 ~~78.~~ 51 47 A kit of parts according to claim 76 wherein at least two of said panels comprises a hook  
2 and loop fastener, respectively.

- 1 ~~79.~~ 52 48 A kit of parts according to claim 76 further comprising a base material adapted for  
2 wearing by a user, with said panels adapted to be secured to said base material.

- 1 ~~80.~~ 53 49 A kit of parts according to claim 79 wherein said base material comprises at least one  
2 pocket, with said panels adapted to be disposed within said at least one pocket.

- 1 ~~81.~~ 54 50 A kit of parts according to claim 76 wherein at least one of said panels comprises at least  
2 one strap adapted for donning said panel to a wearer.

- 1 ~~82.~~ 55 51 A kit of parts according to claim 76 wherein each said panel comprises a backing and a  
2 penetration resistant material covering said backing, with said penetration resistant material  
3 occupying an area less than a total area of said backing.

22

52  
56  
83. A kit of parts according to claim 82 wherein said backing includes an edge, with said  
penetration resistant material covering said backing such that said edge of said backing remains  
exposed.

53  
57  
84. A kit of parts according to claim 76 wherein each said panel comprises a backing, a  
penetration resistant material covering said backing, and a laminate disposed over said  
penetration resistant material.

54  
58  
85. A kit of parts according to claim 76 further comprising a cover adapted to removably  
cover at least one of said panels.

55  
59  
86. A kit of parts according to claim 76 wherein each said panel comprises a penetration  
resistant material and a hardening material cooperating with said penetration resistant material.

56  
60  
87. A kit of parts according to claim 86 wherein each said panel further comprises a  
crystalline material adhered to said hardening material.

57  
61  
88. A kit of parts according to claim 87 wherein said crystalline material is selected from the  
group consisting of ceramic, garnet, metal, silicon carbide, aluminum oxide and diamond.

89. A penetration resistant garment comprising:  
a plurality of light-weight, rigid, discrete penetration resistant sections cooperating with  
and arranged relative to one another to provide a flexible garment.

90. A panel construction for use in a penetration resistant garment, with said panel  
construction comprising:  
a backing; and,  
at least two layers of penetration resistant material covering said backing.

91. A panel construction according to claim 90 further comprising a spacer material disposed  
between said at least two layers of penetration resistant material.



Sub 1 50. A garment according to claim 49 wherein said panels define a plurality of fastening  
2 locations.

1 51. A garment according to claim 50 further comprising a hook and loop fastener disposed  
2 between said first and second panels.

Sub 2 52. A garment according to claim 50 further comprising a snap fastener disposed between  
2 said first and second panels.

1 53. A penetration resistant garment comprising:  
2 an undergarment having penetration resistant properties; and,  
3 a cover removably attached to said undergarment.

1 54. A garment according to claim 53 wherein said cover is disposable.

1 55. A garment according to claim 53 wherein said cover is water resistant.

1 56. A garment according to claim 53 wherein said cover is formed of a spun bonded olefin  
2 material.

1 57. A penetration resistant garment comprising:  
2 a penetration resistant fabric;  
3 a hardening material cooperating with said penetration resistant fabric.

1 58. A garment according to claim 57 wherein said hardening material is an epoxy.

1 59. A garment according to claim 57 further comprising a crystalline material adhered to said  
2 hardening material.

1 60. A garment according to claim 59 wherein said crystalline material is selected from the  
2 group consisting of ceramic, garnet, metal, silicon carbide, aluminum oxide and diamond.

1 67. A panel construction for use in a penetration resistant garment, with said panel  
2 construction comprising:  
3 a backing;  
4 a penetration resistant material covering said backing, with said penetration resistant  
5 material occupying an area less than a total area of said backing.

1 68. A panel according to claim 67 wherein said backing includes an edge, with said  
2 penetration resistant material covering said backing such that said edge of said backing remains  
3 exposed.

1 69. A panel according to claim 67 wherein said backing comprises a foam material.

1 70. A panel construction according to claim 67 wherein said backing material is formed of a  
2 polyester material.

1 71. A panel construction for use in a penetration resistant garment, with said panel  
2 construction comprising:  
3 a backing;  
4 a penetration resistant material covering said backing;  
5 a laminate disposed over said penetration resistant material.

1 72. A panel construction according to claim 71 wherein said laminate is formed of a low  
2 friction material.

1 72. A panel construction according to claim 71 wherein said laminate is formed of a  
2 polypropylene material

1 73. A panel construction according to claim 71 wherein said laminate is sufficient to provide  
2 high durability and abrasion resistance.

1 74. A panel construction according to claim 71 wherein said backing material is formed of a  
2 polyester material.

1 92. A panel construction according to claim 91 wherein said spacer material separates said  
2 penetration resistant garment away from said outer layer by a distance between about .015" and  
3 .025".

1 93. A panel construction according to claim 91 wherein said spacer material comprises a  
2 synthetic yarn formed of at least one of a single and multiple filaments, said yarn having an  
3 denier of greater than 50.

1 94. A panel construction according to claim 93 wherein said filament has a denier of not less  
2 than 50.

1 95. A panel construction according to claim 91 wherein said spacer material comprises one of  
2 foam and felt.

1 96. A panel construction according to claim 91 wherein said spacer material comprises, in  
2 layered construction, a synthetic yarn having at least one of a single and multiple filaments and  
3 one of foam and fibrous felt.

1 97. A panel construction according to claim 96 wherein said synthetic yarn having an denier  
2 of greater than 50.

Added Q3 >

Attorney's Docket No. W0490/7005

Applicant or Patentee: Virginia Howland, Charles A. Howland and Narain Schroeder  
Serial or Patent No.: not yet assigned  
Filed or Issued: Herewith  
For: PENETRATION RESISTANT GARMENT

**DECLARATION CLAIMING SMALL ENTITY STATUS  
(SMALL BUSINESS CONCERN)**

I hereby declare that I am

- ☐ the owner of the small business concern identified below:  
☒ an official of the small business concern empowered to act on  
behalf of the concern identified below:

NAME OF CONCERN: Warwick Mills, Inc.

ADDRESS OF CONCERN: 301 Turnpike Road, New Ipswich, New Hampshire 03071

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled PENETRATION RESISTANT GARMENT by inventor(s), Virginia Howland, Charles A. Howland and Narain Schroeder, described in

- ☒ the specification filed herewith  
☐ application serial no. \_\_\_\_\_, filed \_\_\_\_\_  
☐ patent no. \_\_\_\_\_, issued \_\_\_\_\_.

If the rights held by the small business concern are not exclusive, each individual concern or organization having rights to the invention is listed below\* and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor

under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

- ☐ no such person, concern, or organization  
☐ persons, concerns or organizations listed below \*

\*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

FULL NAME

ADDRESS

☒ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION


I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING Charles A. Howland

TITLE OF PERSON IF OTHER THAN OWNER: Executive Vice President

ADDRESS OF PERSON SIGNING 32 Pidgeon Road, Weston, Massachusetts 02193

✓ SIGNATURE  DATE ✓ 6/21/99



John P. Coleman Justice of the Peace  
June 2000

DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

PENETRATION RESISTANT GARMENT

the specification of which is attached hereto unless the following is checked:

☐ was filed on \_\_\_\_\_, as United States Application No. \_\_\_\_\_ or PCT  
(Include Series Code)  
International Application No. \_\_\_\_\_, bearing attorney docket No. \_\_\_\_\_,  
and was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or section 365(a) of any PCT International application designating at least one country other than the United States listed below and have also identified below any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed:

Prior Foreign PCT International Application(s) and any priority claims under 35 U.S.C. §§119 and 365(a), (b):

(Number)	(Country-if PCT, so indicate)	(DD/MM/YY Filed)	Priority Claimed
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below:

<u>60/105,601</u>	<u>10/26/98</u>
(Application Number)	(filing date)
_____	_____
(Application Number)	(filing date)

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s), or §365(c) of any PCT International application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56

which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application No.)	(filing date)	(status-patented, pending, abandoned)
(Application No.)	(filing date)	(status-patented, pending, abandoned)

PCT International Applications designating the United States:

(PCT Appl. No.)	(U.S. Ser. No.)	(PCT filing date)	(status-patented, pending, abandoned)
-----------------	-----------------	-------------------	---------------------------------------

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

David Wolf	17,528	Peter C. Lando	34,654	Michael G. Verga	39,410
George L. Greenfield	17,756	Gary S. Engelson	35,128	Robert E. Rigby, Jr.	36,904
Stanley Sacks	19,900	Peter J. Gordon	35,164	Robert A. Skrivaneck, Jr.	41,316
Edward F. Perlman	28,105	Randy J. Pritzker	35,986	Robert M. Abrahamsen	40,886
Lawrence M. Green	29,384	Richard F. Giunta	36,149	Lesley A. Hamlin	41,054
Steven J. Henry	27,900	Douglas R. Wolf	36,971	Ivan D. Zitkovsky	37,482
Therese A. Hendricks	30,389	Elizabeth R. Plumer	36,637	Michele J. Young	43,299
Edward R. Gates	31,616	Timothy J. Oyer	36,628	Edward J. Russavage	43,069
William R. McClellan	29,409	John N. Anastasi	37,765	Alan B. Sherr	42,147
Ronald J. Kransdorf	20,004	Helen C. Lockhart	39,248	John C. Gorecki	38,471
M. Lawrence Oliverio	30,915	James M. Hanifin, Jr.	39,213	William G. Gosz	27,787
Charles E. Pfund	17,030	Christopher S. Schultz	37,929	Thomas P. Grodt	41,045
Jason M. Honeyman	31,624	Paul D. Sorkin	39,039	Neil P. Ferraro	39,188
James H. Morris	34,681	John R. Van Amsterdam	40,212	Julie A. Beberman	40,906
		Matthew B. Lowrie	38,228	Lisa E. Winsor	44,405

Address all telephone calls to Neil P. Ferraro at telephone no. (617) 720-3500. Address all correspondence to

Neil P. Ferraro  
c/o Wolf, Greenfield & Sacks, P.C.,  
Federal Reserve Plaza  
600 Atlantic Avenue  
Boston, MA 02210-2211

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Inventor's signature

Full name of sole or first inventor Charles A. Howland

Citizenship United States

Residence 32 Pidgeon Road, Weston, Massachusetts 02193

Post Office Address 32 Pidgeon Road, Weston, Massachusetts 02193

Inventor's signature

Full name of sole or first inventor Virginia Howland


Citizenship United States

Residence 32 Pidgeon Road, Weston, Massachusetts 02193

Post Office Address 32 Pidgeon Road, Weston, Massachusetts 02193

Date

Date

  
Inventor's signature

6-21-99  
Date

Full name of second or joint inventor Narain Schroeder

Citizenship United States

Residence 184 Main Street, Apt. 401, Nashua, NH 03060

Post Office Address 184 Main Street, Apt. 401, Nashua, NH 03060

6-21-99



06/24/99

JCS06 U.S. PTO

A

**UTILITY  
PATENT APPLICATION  
TRANSMITTAL**(Only for new nonprovisional applications under 37  
CFR 1.53(b))

Attorney Docket No. W0490/7005

First Named Inventor or Application Identifier

Charles HOWLAND

Express Mail Label No.

EL025155493US

Date of Deposit

June 24, 1999

JCS06 U.S. PTO  
09/339137

06/24/99

**APPLICATION ELEMENTS**

See MPEP chapter 600 concerning utility patent application contents

**ADDRESS**

TO:

Assistant Commissioner for Patents  
Box Patent Application  
Washington, DC 20231

1. ☒ **Fee Transmittal Form**  
(Submit an original, and a duplicate for fee processing)
2. ☒ **Specification** [Total pages 26]  
13 pages specification  
1 pages abstract  
12 pages claims  
97 claims
3. ☒ **Drawing(s) (35 USC 113)** [Total sheets 16]  
☒ Informal ☐ Formal [Total drawings 16]
4. ☒ **Oath or Declaration** [Total pages]  
a. ☒ Newly executed (original or copy)  
b. ☐ Copy from a prior application (37 CFR 1.63(d))  
(for continuation/divisional with Box 17 completed)  
[Note Box 5 below]  
i. ☐ **DELETION OF INVENTOR(S)**  
Signed statement attached deleting  
inventor(s) named in the prior application, see  
37 CFR 1.63(d)(2) and 1.33(b).
5. ☐ **Incorporation by Reference**  
(usable if Box 4b is checked)  
The entire disclosure of the prior application,  
from which a copy of the oath or declaration is  
supplied under Box 4b, is considered as being  
part of the disclosure of the accompanying  
application and is hereby incorporated by  
reference therein.

6. ☐ Microfiche Computer Program (Appendix)  
7. ☐ Nucleotide and/or Amino Acid Sequence  
Submission (if applicable, all necessary)  
a. ☐ Computer Readable Copy  
b. ☐ Paper Copy (identical to computer copy)  
c. ☐ Statement verifying identity of above copies

**ACCOMPANYING APPLICATION PARTS**

8. ☒ Assignment Papers (cover sheet & documents(s))  
9. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney  
(when there is an assignee)  
10. ☐ English Translation of Document (if applicable)  
11. ☒ Information Disclosure ☒ Copies of IDS  
Statement (IDS)/PTO-1449 Citations  
12. ☐ Preliminary Amendment  
13. ☒ Return Receipt Postcard (MPEP 503)  
(Should be specifically itemized)  
14. ☒ Small Entity ☐ Statement filed in prior  
Statement(s) application, Status still proper  
and desired  
15. ☐ Certified Copy of Priority Document(s)  
(if foreign priority is claimed)

16. The following application claims benefit of  
Provisional Application Serial No. 60/105,601 filed  
October 26, 1998 entitled PENETRATION RESISTANT  
GARMENT under 35 U.S.C. §119(e).

17. If a **CONTINUING APPLICATION**, check appropriate box and supply the requisite information:

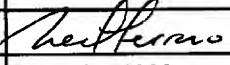
- ☐ Continuation    ☐ Divisional    ☐ Continuation-in-part (CIP)    of prior application No.:
- ☐ Cancel in this application original claims of the prior application before calculating the filing fee.
- ☐ Amend the specification by inserting before the first line the sentence:

**18. CORRESPONDENCE ADDRESS**

*Correspondence address below*

<b>ATTORNEY'S NAME</b>	Neil P. Ferraro, Reg. No. 39,188				
<b>NAME</b>	Wolf, Greenfield & Sacks, P.C.				
<b>ADDRESS</b>	600 Atlantic Avenue				
<b>CITY</b>	Boston	<b>STATE</b>	MA	<b>ZIP</b>	02210
<b>COUNTRY</b>	USA	<b>TELEPHONE</b>	(617) 720-3500	<b>FAX</b>	(617) 720-2441

**19. SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED**

<b>NAME</b>	Neil P. Ferraro, Reg. No. 39,188
<b>SIGNATURE</b>	
<b>DATE</b>	June 24, 1999

Inventor or Identifier: Charles Howland

Serial No: Not yet assigned

Filed: Herewith

For: PENETRATION RESISTANT GARMENT

CHECK BOX, if applicable:

☐ **DUPLICATE**

## Fee Calculation Sheet

CLAIMS	FOR	NUMBER FILED	NUMBER EXTRA	RATE	FEE
	TOTAL CLAIMS (37 CFR 1.16(c))	97-20=	77 x	\$18	= \$1386.00
	INDEPENDENT CLAIMS (37 CFR 1.16(b))	13-3=	10 x	\$78	= \$780.00
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d)) +			\$	= \$
				BASIC FEE (37 CFR 1.16(a))	\$760.00
	Total of above Calculations =				\$2926.00
	Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28).				\$1463.00
	Assignment Recordation Fee (if any)				\$ 40.00
	Other Fees (e.g., Petition for Extension of Time), if any <b>NOTE: Enter small-entity amount if applicable.</b>				\$
	TOTAL =				\$1503.00

1. A check in the amount of \$1503.00 is enclosed.

## General Authorization to Charge Deposit Account and General Request for Extension of Time

2. a. ☒ If the filing of any paper in this application necessitates the payment of a fee under 37 CFR § ☒ 1.16 ☒ 1.17 or ☐ 1.18, and the fee due is in an amount different from any enclosed check or if no check is enclosed, the Commissioner is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 23/2825.
- b. ☐ The applicant hereby revokes any prior authorization to charge a fee due under 37 CFR § ☐ 1.16 ☐ 1.17 or ☐ 1.18.
3. If the filing of any paper in this application necessitates an extension of time under 37 CFR § 1.136(a), the applicant hereby requests such extension of time. If the fee due is in an amount different from any enclosed check or if no check is enclosed, the Commissioner is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 23/2825.



Neil P. Ferraro, Reg. No. 39,188  
 Wolf, Greenfield & Sacks, P.C.  
 600 Atlantic Avenue  
 Boston, MA 02210-2211  
 (617) 720-3500  
 Attorneys of Record

Docket No. W0490/7005  
 Date: June 24, 1999

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 06/24/99